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# Pizza.py Documentation

(7 Nov 2005 version of Pizza.py)

Pizza.py is a loosely integrated collection of tools written in Python, many of which provide pre- and post-processing capability for the LAMMPS molecular dynamics package. There are tools to create input files, convert between file formats, process log and dump files, create plots, and visualize and animate simulation snapshots.

The name Pizza.py is meant to evoke the aroma of a collection of "toppings" that the user can combine in different ways on a "crust" of basic functionality, with Python as the "cheese" that glues everything together.

The maintainer of Pizza.py is Steve Plimpton at Sandia National Laboratories, a US Department of Energy (DOE) laboratory. Many of the tools were written by Matt Jones, a BYU student who spent a summer at Sandia. The Pizza.py WWW Site at [www.cs.sandia.gov/~sjplimp/pizza.html](http://www.cs.sandia.gov/~sjplimp/pizza.html) has more information about Pizza.py and its uses.

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The Pizza.py documentation is organized into the following sections. If you find errors or omissions in this manual or have suggestions for useful information to add, please send an email to [sjplimp@sandia.gov](mailto:sjplimp@sandia.gov) so we can improve the Pizza.py documentation.

PDF file of the entire manual, generated by htmldoc

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List of tools in Pizza.py:

<u>animate.py</u>	Animate a series of image files
<u>chain.py</u>	

	Create bead-spring chains for LAMMPS input
<a href="#"><u>data.py</u></a>	Read, write, manipulate LAMMPS data files
<a href="#"><u>dump.py</u></a>	Read, write, manipulate LAMMPS dump files and atom attributes
<a href="#"><u>gl.py</u></a>	3d interactive visualization via OpenGL
<a href="#"><u>gnu.py</u></a>	Create plots via <a href="#"><u>GnuPlot</u></a> plotting program
<a href="#"><u>image.py</u></a>	View and manipulate images
<a href="#"><u>log.py</u></a>	Read LAMMPS log files and extract thermodynamic data
<a href="#"><u>matlab.py</u></a>	Create plots via <a href="#"><u>MatLab</u></a> numerical analysis program
<a href="#"><u>pair.py</u></a>	Compute LAMMPS pairwise energies
<a href="#"><u>patch.py</u></a>	Create patchy Lennard-Jones particles for LAMMPS input
<a href="#"><u>pdb.py</u></a>	Read, write PDB files in combination with LAMMPS snapshots
<a href="#"><u>plotview.py</u></a>	Plot multiple vectors from a

	data set
<a href="#"><u>rasmol.py</u></a>	3d visualization via <a href="#"><u>RasMol</u></a> program
<a href="#"><u>raster.py</u></a>	3d visualization via <a href="#"><u>Raster3d</u></a> program
<a href="#"><u>svg.py</u></a>	3d visualization via <a href="#"><u>SVG</u></a> files
<a href="#"><u>vcr.py</u></a>	VCR–style GUI for 3d interactive OpenGL visualization
<a href="#"><u>vec.py</u></a>	Read columns of numbers from a file
<a href="#"><u>vtk.py</u></a>	Convert LAMMPS snapshots to VTK format
<a href="#"><u>xyz.py</u></a>	Convert LAMMPS snapshots to XYZ format

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## 1. Introduction

These sections describe what Pizza.py is, what it means to be open–source software, and acknowledge the funding and people who have contributed to Pizza.py.

1.1 [What is Pizza.py](#)

1.2 [Open source distribution](#)

1.3 [Acknowledgements](#)

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### 1.1 What is Pizza.py

Pizza.py is a loosely integrated collection of tools, many of which provide pre– and post–processing capabilities for the [LAMMPS](#) molecular dynamics package. Over time, new tools will be added to Pizza.py to support other applications as well.

There are LAMMPS–related tools to create input files, convert between file formats to connect to other codes, process log and dump files, plot output, and visualize and animate simulation snapshots.

Python is used in Pizza.py in 3 ways:

- to provide an interactive and scripting interface to the tools
- as a language for writing tools
- to wrap existing stand-alone codes

Python makes it easy for users of Pizza.py to:

- experiment with tools interactively
- automate tasks as script files of commands
- extend tools or create new ones

The topmost level of Pizza.py adds a modest bit of functionality to the Python interpreter to make it easier to invoke tools and pass data between them. As such, Python is an ideal "framework" or "glue" language that enables various tools to be hooked together, while also providing a rich programming environment of its own.

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## 1.2 Open source distribution

Pizza.py comes with no warranty of any kind. As each source file states in its header, it is distributed free-of-charge, under the terms of the [GNU Public License \(GPL\)](http://www.gnu.org/licenses/gpl.html). This is often referred to as open-source distribution – see [www.gnu.org](http://www.gnu.org) or [www.opensource.org](http://www.opensource.org) for more details. The legal text of the GPL is in the LICENSE file that is included in the Pizza.py distribution.

Here is a summary of what the GPL means for Pizza.py users:

- (1) Anyone is free to use, modify, or extend Pizza.py in any way they choose, including for commercial purposes.
- (2) If you distribute a modified version of Pizza.py, it must remain open-source, meaning you distribute it under the terms of the GPL. You should clearly annotate such a code as a derivative version of Pizza.py.
- (3) If you release any code that includes Pizza.py source code, then it must also be open-sourced, meaning you distribute it under the terms of the GPL.
- (4) If you give Pizza.py to someone else, the GPL LICENSE file and source file headers (including the GPL notices) should remain part of the code.

In the spirit of an open-source code, these are various ways you can contribute to making Pizza.py better. You can send email to [sjplimp@sandia.gov](mailto:sjplimp@sandia.gov) on any of these items.

- If you write a Pizza.py script that is generally useful or illustrates how to do something cool with Pizza.py, it can be added to the Pizza.py distribution. Ditto for a picture or movie that can be added to the [Pizza.py WWW site](http://www.pizza.py).
  - If you add a new method to one of the tools or create a new tool that is useful for Pizza.py or LAMMPS users, it can be added to the Pizza.py distribution. See the ToDo list at the beginning of the `src/*.py` files for features that haven't yet been implemented.
  - If you find a bug, report it.
  - Report if you find an error or omission in the [Pizza.py documentation](http://www.pizza.py) or on the [Pizza.py WWW Site](http://www.pizza.py), or have a suggestion for something to clarify or include.
  - Point prospective users to the [Pizza.py WWW Site](http://www.pizza.py) or link to it from your WWW site.
-

### 1.3 Acknowledgements

Pizza.py has been developed at [Sandia National Laboratories](#) which is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Funding for Pizza.py development has come from the US Department of Energy ([DOE](#)), through its LDRD and Genomes-to-Life programs. The latter effort has been funded by DOE's [OASCR](#) and [OBER](#) offices as part of the US Department of Energy's Genomics:GTL program ([www.doe.genomestolife.org](http://www.doe.genomestolife.org)) under the [project](#), "Carbon Sequestration in Synechococcus Sp.: From Molecular Machines to Hierarchical Modeling".

The maintainer of Pizza.py is [Steve Plimpton](#).

Matt Jones, a BYU student who was a summer intern at Sandia, wrote several of the coolest tools in Pizza.py and about half the code in the initial version.

Others who have written tools or scripts that are part of the Pizza.py distribution are listed on the [Pizza.py WWW site](#).

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## 2. Installing Pizza.py

Unpack the Pizza.py distribution by typing the following:

```
gunzip pizza.tar.gz
tar xvf pizza.tar
```

The Pizza.py main directory should then contain the following directories:

README	initial instructions
LICENSE	the GNU open-source license
doc	HTML documentation for Pizza.py
examples	scripts and data sets that exercise Pizza.py tools
scripts	various Pizza.py script files
src	source code for Pizza.py and its tools

Because Python is an interpreted language, there is no need to compile or "make" Pizza.py. You run Pizza.py

by executing the `src/pizza.py` file directly, as described below. However there are 3 issues to consider: (a) you must have Python installed on your machine, (b) some Pizza.py tools require your Python to be extended with additional Python packages, and (c) some Pizza.py tools are wrappers on other software which needs to be available on your system.

If you don't plan to use a particular Pizza.py tool, you don't need to install additional Python packages or other software it requires.

## 2.1 Installing Python

## 2.2 Running Pizza.py

## 2.3 Setting up the DEFAULTS.py file

## 2.4 Installing additional Python packages

## 2.5 Installing other software

Note that we cannot provide help on installing the various software packages described here. If you have problems, you'll need to talk to a local expert who can help you with your machine. If you find that instructions on this page are incorrect or incomplete or you can provide a better description of the install procedure, please send an email to [sjlimp@sandia.gov](mailto:sjlimp@sandia.gov).

---

## Installing Python

Python is open-source software available for Unix, Macintosh, and Windows machines. If you have a Linux box or Mac it is probably already installed. If the python executable is in your path, typing "python" should give you a Python prompt ">>>" and tell you what version you are running. Version 2.3 or 2.4 is sufficiently current to run Pizza.py, though older versions may work as well.

If Python is not installed on your machine, go to [www.python.org](http://www.python.org) to download a binary or source-code version and then build and/or install it.

---

## Running Pizza.py

Typically Pizza.py should be run from the directory where your LAMMPS or other data files are. Like any Python program, Pizza.py can be run in one of 2 ways, by typing either

```
python -i ~/pizza/src/pizza.py
~/pizza/src/pizza.py
```

where the last argument is the full pathname of the pizza.py file.

The `-i` switch leaves Python in interactive mode (instead of exiting) after the pizza.py script is run. In the 2nd case, if the src dir is in your path, just pizza.py could be typed. For the 2nd case, you must also set `src/pizza.py` to be an executable file (`chmod +x pizza.py`) and edit the 1st line of pizza.py to reflect where Python lives on your system (find it by typing "which python"), e.g.

```
#!/usr/local/bin/python -i
```

Putting a definition like one of the following in your `.cshrc` file (or equivalent syntax for other Unix shell start-up files) will let you simply type "pizza" at the command-line to start Pizza.py.

```
alias pizza python -i ~/pizza/src/pizza.py alias pizza ~/pizza/src/pizza.py
```

Pizza.py accepts several command-line options; they are described in [this section](#) of the documentation.

When Pizza.py starts, it reads a few values from the src/DEFAULTS.py file (described below) and imports the \*.py files from the src directory as Python modules. These are the Pizza.py tools. Error messages will be printed if your Python has not been extended with a Python package that a tool requires. If you don't plan to use the tool you can ignore the message, or exclude that tool via a command-line switch.

Once all tools have been loaded and any initial scripts and commands have been run (via command-line arguments) you should see the Pizza.py ">" prompt. From this point on, everything you type is a Python command. Python interprets what you type, operates on your data, and produces output or error messages, just as if you were typing in response to Python's interactive prompt ">>>".

You can also type special commands that have been added to the Python interpreter by Pizza.py or commands that invoke Pizza.py tools. More details about these options are explained in [this section](#) of the documentation.

As with Python, type Ctrl-D to exit Pizza.py at any time.

---

## Setting up the DEFAULTS.py file

When Pizza.py starts it reads 3 values from the src/DEFAULTS.py file:

PIZZA_TOOLS	directories that contain additional Pizza.py tools
PIZZA_SCRIPTS	directories that contain additional Pizza.py scripts
PIZZA_EXCLUDE	Python files that are not loaded, since they are not tools

These are designed to allow users to augment Pizza.py with their own tools and scripts, which need not be stored in the directories of the Pizza.py package. Follow the instructions in the DEFAULTS.py file for using these options.

The DEFAULTS.py file also contains various variables that specify the name and path of programs that Pizza.py tools will execute on your system. In some cases the variables contain settings that are used by these programs. Read the comments in the DEFAULTS.py file for more information.

The following table lists the keywords in the DEFAULTS.py, the program or setting that will be used by default if the keyword line is commented out, and the Pizza.py tools that use the keyword. If the program is



not in your path or you wish to use an alternate program or setting, you must edit the DEFAULTS.py file accordingly. If you don't plan to use any tool that needs the keyword, you can ignore its setting.

Keyword	Default Value	Purpose	Tools that Use it
DISPLAY	display	display image files (ImageMagick)	rasmol, raster, svg
CONVERT	convert	convert image files (ImageMagick)	image
MONTAGE	montage	montage image files (ImageMagick)	image
GNUPLOT	gnuplot	Gnu Plotting package	gnu
GNUTERM	x11	GnuPlot terminal	gnu
GUNZIP	gunzip	unzip a compressed *.gz file	dump, log
LABEL3D	label3d	put a label on a Raster3D image	raster
MATLAB	matlab	MatLab numerical analysis & plotting package	matlab
RASMOL	rasmol	RasMol molecular vizualization package	rasmol
RENDER	render	Raster3D vizualization rendering engine	raster

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## Installing additional Python packages

This is the list of extra Python packages various Pizza.py tools require. If a tool is not listed it requires no extra packages. Instructions on where to find the Python extensions and how to install them are listed below.

Package	Tools that Use it
Numeric	dump
PIL	

	animate, gl, image
Pmw	image
PyOpenGL	gl
readline	Pizza.py itself
Tkinter	animate, image, plotview

## Numeric

Numeric enables Python to process vectors and arrays of numbers efficiently, both in memory and CPU speed. It's an extremely useful extension to have in your Python if you do any numerical work on large data sets. Note that Pizza.py uses the older (but still popular) Numeric package, not the newer numarray package.

If Numeric is already installed in your Python, you should be able to type the following without getting an error:

```
>>> import Numeric
```

Numeric can be downloaded from [this site](#). Version 23 or newer is fine. Once unpacked, you can type the following from the Numeric directory to install it in your Python.

```
python setup.py install
```

## PIL

The PIL (Python Imaging Library) allows Python to read image files, manipulate them, and convert between several common image formats.

If PIL is already installed in your Python, you should be able to type the following without getting an error:

```
>>> import Image,ImageTk
```

PIL can be downloaded from [this site](#). Version 1.1.4 is fine. Once the Imaging-1.1.4 tar file is unpacked, follow the instructions to insure that PIL is linked to the correct libraries for image formats you intend to use. The actual installation can be done by typing

```
python setup.py install
```

## Pmw

Pmw (Python mega-widgets) is a common Tkinter extension that provides a host of more powerful GUI widgets.

If Pmw is already installed in your Python, you should be able to type the following without getting an error:

```
>>> import Pmw
```

Pmw can be downloaded from [this site](#). Version 1.2 is fine. Pmw is installed by placing its files in your Python's site-packages directory. This install text is from the Pmw distribution:

... assuming you have placed the tar file in the /tmp directory, you can simply run the following commands:

```
cd /usr/lib/python2.2/site-packages
gunzip /tmp/Pmw.1.2.tar.gz (or gzip -d /tmp/Pmw.1.2.tar.gz)
tar xvf /tmp/Pmw.1.2.tar
```

If you do not have write permission for these standard directories, place the Pmw directory somewhere on your PYTHONPATH or sys.path. If this is not possible, place the Pmw directory somewhere else and add the parent directory to your PYTHONPATH or sys.path.

## PyOpenGL

The [PyOpenGL](#) package is a wrapper on the ubiquitous OpenGL graphics library and allows a Python program to make graphics calls in standard OpenGL syntax. It also includes Togl (Tcl/Tk) support for opening a Tk OpenGL widget, which Pizza.py uses.

If PyOpenGL is already installed in your Python, you should be able to type the following without getting an error:

```
>>> import OpenGL
```

PyOpenGL can be downloaded from [this site](#) on SourceForge. You want the latest PyOpenGL release (not OpenGLContext). After you have downloaded the needed files, you will want to read the [PyOpenGL installation instructions](#). If you are installing from source, you can hopefully type the following from the PyOpenGL directory to install it in your Python, though in my experience it doesn't always work transparently:

```
python setup.py install
```

Note that running PyOpenGL requires your system have OpenGL, GLUT, Tcl/Tk, PIL, and Numeric libraries already installed. The GL and Tck/Tk libraries are already in place on most Linux systems.

## readline

Support for the [readline](#) library is part of Python but is not supported on all systems. If it works in your Python, then Pizza.py (and Python) prompts are more shell-like and should support arrow keys, Emacs-style editing, command history, etc. If you get an error "No module named readline" when Pizza.py starts up, you can ignore it, or comment out the line "import readline" in pizza.py.

If readline is already installed in your Python, you should be able to type the following without getting an error:

```
>>> import readline
```

The readline library can be downloaded from [this site](#). After building the library, I believe you then have to rebuild Python for Python to work with it.

## Tkinter

The Tkinter package is part of Python but is not always enabled when Python is built. If you can type the following without an error message in your Python, then Tkinter is operational in your Python:

```
>>> import Tkinter
>>> Tkinter._test()
```

If not, [this WWW page](#) explains how to determine what your Python lacks and how to fix it. Unfortunately these instructions are not 100% clear to me. They also typically require root privilege on your system.

Alternatively, you can install your own version of Python, insure that Tkinter is enabled when you build it, and make the new Python your default (i.e. put it first in your path, or point to it with an alias or link). This is what I did, but unfortunately, this is also a non-trivial procedure.

If any Python aficionado understands a better way to enable Tkinter or can explain it more clearly, I'd appreciate an email to [sjplimp@sandia.gov](mailto:sjplimp@sandia.gov).

---

## Installing other software

Some Pizza.py tools invoke other software which must be installed on your system for the tool to work. This is an alphabetic list of the needed software. Except where noted, it is freely available for download on the WWW. The Pizza.py tools that use this software are listed above in [this section](#).

### ImageMagick display, convert, montage commands

Several Pizza.py tools display image files. The ImageMagick "display" program can be used for this purpose. Likewise, the ImageMagick "convert" and "montage" comands are used by the image tool. The ImageMagick toolkit can be downloaded from [this site](#) and contains a variety of useful image conversion and manipulation software.

## GnuPlot

The Pizza.py gnu tool is a wrapper on the open-source GnuPlot program. GnuPlot can be downloaded from [this site](#).

## Gunzip

Gunzip is invoked by Python to read compressed (\*.gz) data and dump files. It is almost certainly on your Unix system (type "which gunzip"). If not it can be downloaded from [this site](#).

## Label3d

The Pizza.py tool raster uses the label3d and render programs from the Raster3d visualization package to produce high-quality ray-traced images. See the description of "Render" below for information about Raster3d.

## MatLab

The Pizza.py matlab tool is a wrapper on MatLab which is a widely-used commercial numerical analysis package that also produces nice plots. Further information is available at [the MathWorks WWW site](#). When

MatLab is installed on your system and the appropriate environment variables are set, the command "matlab" should launch the program.

## RasMol

The Pizza.py rasmol tool invokes the RasMol visualization package to view molecular systems and produce nice images. RasMol can be downloaded from [this site](#), which is for the original open-source version of RasMol, not the Protein Explorer derivative version of RasMol.

Note that when using RasMol on a Mac, you will need to launch X11 first (or run Pizza.py from an X11 xterm) to get RasMol to display properly.

## Render

The Pizza.py tool raster uses the render and label3d programs from the Raster3d visualization package to produce high-quality ray-traced images. Raster3d can be downloaded from [this site](#).

For Macs, Raster3d is available for download via [Fink](#) as an [unstable package](#).

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## 3. Basics of using Pizza.py

The [previous section](#) describes how to install and run Pizza.py and the various software it uses. After Pizza.py has started you should see a ">" prompt. The following sections describe what comes next:

- 3.1 [Python syntax](#)
  - 3.2 [Pizza.py command line arguments](#)
  - 3.3 [Pizza.py extensions to the Python interpreter](#)
  - 3.4 [Using Pizza.py tools](#)
  - 3.5 [Running Pizza.py and Python scripts](#)
  - 3.6 [Error messages](#)
- 

### 3.1 Python syntax

Aside from its tools, Pizza.py itself simply adds a bit of functionality to the Python interpreter to enable it to more easily launch shell commands and scripts and invoke its tools. Pizza.py's ">" prompt is different from Python's ">>>" prompt to indicate the extra functionality is available, but you can type any Python command you would type at the Python prompt.

Python is a powerful scripting and programming language, similar in scope and universality to Perl. This little Pizza.py manual cannot attempt to teach you how to use Python, its syntax, or its rich set of powerful built-in commands. If you only use the extra tools provided by Pizza.py, you can think of Pizza.py as an application with a self-contained set of commands. However, if you learn more about Python, you will be able to write more powerful Pizza.py scripts, access and manipulate data stored inside Pizza.py tools, or even add your own commands and tools, which need not have anything to do with LAMMPS.

You can learn about Python at [www.python.org](http://www.python.org). My most-used Python book is [Essential Python](#) by Dave Beazley which assumes some programming experience but covers both the basics of Python and its many powerful libraries in a well-written, concise manner.

---

## 3.2 Pizza.py command line arguments

When running Pizza.py, several command-line options can be added as switches, e.g.

```
pizza.py switch args switch args ...
```

-s	silent (else print start-up help)
-t log dump raster	load only these tools
-x raster rasmol	load all tools except these
-f file arg1 arg2	run script file with args
-c "vec = range(100)"	run Python command
-q	quit (else interactive)

Switches can appear in any order and be used multiple times. The -f scripts and -c commands are executed in the order they appear. Script files are Python files which can contain Python or Pizza.py tool commands. Pizza.py looks for script files in 3 places: your current working directory, the pizza/scripts directory, and any extra directories you list in the src/DEFAULTS.py file. This means you can add your own scripts to pizza/scripts or to directories of your choosing.

The argument of the -c switch will typically need to be enclosed in quotes to avoid being interpreted by the shell. This also allows multiple Python commands to be separated by semi-colons, e.g.

```
-c "a = range(100); print a"
```

---

## 3.3 Pizza.py extensions to the Python interpreter

As mentioned above, the standard Python syntax is extended a bit at the Pizza.py ">" interactive prompt. These options were inspired by the [LazyPython.py](#) code of Nathan Gray, which taught me how to extend the Python interpreter. These are the short-cuts:

?	print help message
??	one-line for each tool and script
? raster	list tool commands or script syntax
?? energy.py	

	full documentation of tool or script
!ls -l	shell command
@cd ..	cd to a new directory
@log tmp.log	log all commands typed so far to file
@run block.py arg1 arg2	run script file with args
@time d = dump("*.dump")	time a command

Shell commands begun with a "!" can include the redirection operators "". The shell command "!cd" will not change directories permanently; use the "@cd" short-cut instead. Any short-cut command starting with "@" can be abbreviated with one or more letters. E.g. "@r" is the same as "@run". The @log command requires that the Python readline library be available on your system.

Each of the above short-cuts can be performed by native Python commands; they are just not as simple to type. Here is how several of the short-cuts can be written in Python, which is what you need to do in a script, since the above short-cuts only work at the Pizza.py interactive prompt:

Short-cut	Native Python
!ls -l	sys.command("ls -l")
@cd ..	os.chdir("../")
@run myfile.py	execfile("myfile.py")
CTRL-D	sys.exit()

### 3.4 Using Pizza.py tools

The tools that Pizza.py adds to Python are each implemented as a single Python class (e.g. dump, log, raster), so the first step in using a tool is to create an instance of the class (an object). Each class defines a set of methods (functions) that operate on the objects you create and their associated data. Each method, including the constructor, takes zero or more arguments, which may be previously created objects. In practical terms, this means that you type commands like this:

```
d = dump("dump.*")
p = pdb("my.pdb",d)
p.many()
dnew = dump("dump.all")
```

The first 2 commands create dump and pdb objects named "d" and "p" respectively. The "d" and "p" are Python variable names; you could use any names you wish: "dump12" or "Dump\_mine" or whatever. The 3rd line invokes the "many" method within the pdb class for the pdb object "p". This method writes out a series of PDB files using the snapshots in "d" which was passed to "p" when it was created. The final command creates a new dump object "dnew" from another LAMMPS dump file. You can create and manage as many objects (of the same or different classes) simultaneously as you wish. If the last line assigned the object to "d", the

original dump object with the same name would be deleted by Python.

Various Pizza.py tools create temporary files as they operate. These are all named tmp.\*. Pizza.py does not clean up all of these files, since they are sometimes useful to look at for debugging or other purposes.

Python syntax allows for powerful combinations of tools to be invoked in one or a few commands. For example

```
lg = log("log.*")
m = matlab()
plotview(lg,m)
```

could be abbreviated as

```
plotview(log("log.*"),matlab())
```

With the `-c` command line switch, this one-liner could be specified when Pizza.py is launched. This example also illustrates that created objects (like the plotview object) do not need to be assigned to variables if they will not be accessed in subsequent commands.

---

### 3.5 Running Pizza.py and Python scripts

A file containing Python and/or Pizza.py commands can be executed as a script and arguments can be passed to it (if desired). The script can be run in several different ways:

(1) From the Pizza.py command line

```
% pizza -f script.sample file.test 10 ...
```

(2) From the Pizza.py interactive prompt

```
> @run script.sample file.test 10 ...
```

(3) From the Python command line

```
% python -i script.sample file.test 10 ...
```

(4) From a shell prompt with `#!/usr/local/bin/python -i` as 1st line of script

```
% script.sample arg1 arg2 ...
```

(5) From the Python interactive prompt

```
>>> argv = 0,"file.test","10",...
>>> execfile("script.sample")
```

(6) As a nested script from within another Python or Pizza.py script file

```
argv = 0,"file.test","10",...
execfile("script.sample")
```

The Pizza.py interpreter short-cut commands described in the next section cannot be used in a script file.



There are 2 additional issues to address in your script files.

(A) First, if the script uses Pizza.py commands and you want to run it from Python itself (methods 3,4,5,6), then your script should import the necessary Pizza.py tools directly. E.g. if your script uses the log and matlab tools, you would put these lines at the top:

```
from log import log
from matlab import matlab
```

This is OK to do even if the script will be run by Pizza.py since it doesn't matter that Pizza.py already imported the tools. Note that if you do this, you can then give your script file and the Python tool \*.py files it uses to someone who doesn't have Pizza.py and they can run your script with their Python.

(B) Second, if your script takes arguments and you want the same script to run identically for all 6 methods, then you need to include this line at the beginning of the script:

```
if not globals().has_key("argv"): argv = sys.argv
```

This will enable the arguments to be accessed in the script as argv1 for the 1st argument, argv2 for the 2nd, etc.

This works because in methods 3,4 Python stores the script arguments in sys.argv and the script name in sys.argv0. The above line of Python code copies sys.argv to argv. When Pizza.py runs the script (methods 1,2) it loads the arguments directly into the "argv" variable. Methods 5,6 load the arguments into argv explicitly before executing the script via execfile(). In this case argv0 is a dummy argument to conform with the Python convention for sys.argv.

Also note in methods 5,6 that all arguments such as "10" must be strings even if they are numeric values, since this is the way they are passed to the script in methods 1,2,3,4.

As an example of the flexibility enabled by combining scripts, arguments, and command-line options in Pizza.py, consider the 3-line example of the previous sub-section. We modify the script as follows and save it as logview.py:

```
files = ' '.join(argv1:) # create one string from list of filenames
lg = log(files)
m = matlab()
plotview(lg,m)
```

If an alias is defined in your shell start-up file, such as

```
alias logview ~/pizza/src/pizza.py -f logview.py
```

then you can type the following one-liner at the shell prompt to invoke Pizza.py on the logview.py script with a list of files you specify.

```
% logview log.1 log.2 ...
```

A set of plots and a control GUI will appear on your screen.

---

### 3.6 Error messages

If you mistype a Pizza.py or Python command or pass an invalid argument to a tool method, an error message will be printed by Python. Usually these will be self-explanatory. Sometimes they will point to a line of code inside a tool which Python was unable to execute successfully. This could be because you passed the wrong arguments to the tool, the data the tool is operating on is invalid, or because there's a bug in the tool. In the latter case, please figure out as much as you can about the bug and email a description and the necessary files to reproduce the bug in the simplest possible way to [sjplimp@sandia.gov](mailto:sjplimp@sandia.gov).

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## 4. Tools within Pizza.py

[The previous section](#) describes how Pizza.py tools are used in Pizza.py.

Help on the syntax for invoking a tool and using its methods and settings can be accessed interactively within Pizza.py itself by typing "? tool" or "?? tool". Typing "???" gives a one-line description of each tool.

These are the different categories of Pizza.py tools:

LAMMPS in/out files	chain, data, dump, log, patch
Visualization	gl, rasmol, raster, svg
File conversion	pdb, vtk, xyz
GUI wrappers	animate, image, plotview, vcr
Plotting	gnu, matlab
Miscellaneous	pair, vec

Within the plotting and viz categories, individual tools share many common methods, so the tools can often be used interchangeably. For example, the same script can produce an animation using either Raster3d or SVG to generate the movie frames, by simply changing the line that creates the visualizer object, or by passing the object into the script as an argument.

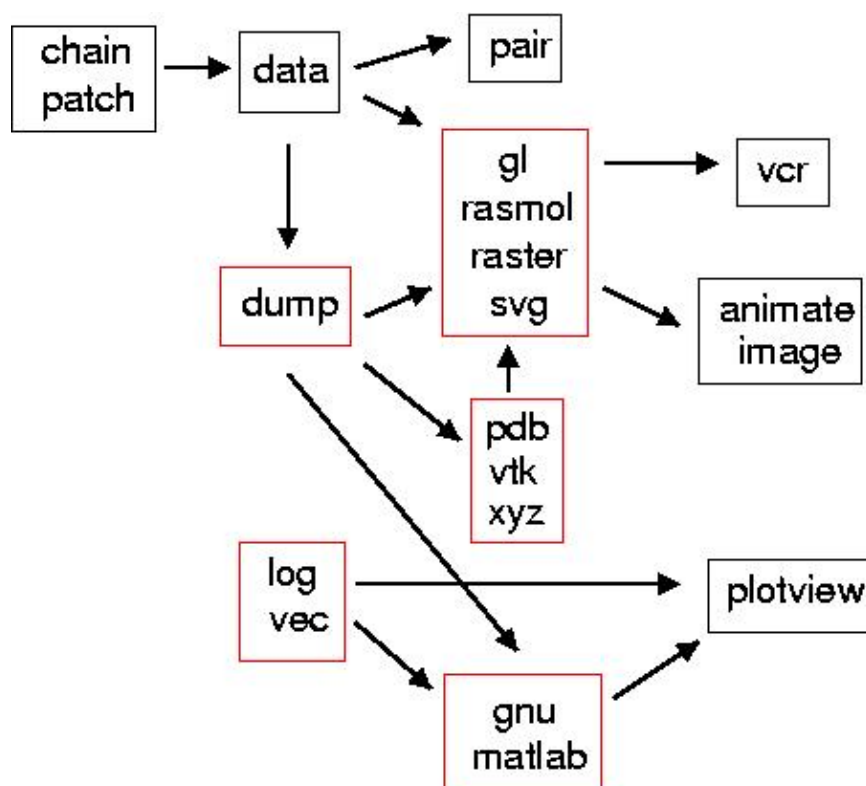
This is the complete list of tools in Pizza.py; the link is to each tool's documentation page.

<a href="#">animate.py</a>	Animate a series of image files
<a href="#">chain.py</a>	Create bead-spring

	chains for LAMMPS input
<a href="#"><u>data.py</u></a>	Read, write, manipulate LAMMPS data files
<a href="#"><u>dump.py</u></a>	Read, write, manipulate LAMMPS dump files and atom attributes
<a href="#"><u>gl.py</u></a>	3d interactive visualization via OpenGL
<a href="#"><u>gnu.py</u></a>	Create plots via <a href="#"><u>GnuPlot</u></a> plotting program
<a href="#"><u>image.py</u></a>	View and manipulate images
<a href="#"><u>log.py</u></a>	Read LAMMPS log files and extract thermodynamic data
<a href="#"><u>matlab.py</u></a>	Create plots via <a href="#"><u>MatLab</u></a> numerical analysis program
<a href="#"><u>pair.py</u></a>	Compute LAMMPS pairwise energies
<a href="#"><u>patch.py</u></a>	Create patchy Lennard–Jones particles for LAMMPS input
<a href="#"><u>pdb.py</u></a>	Read, write PDB files in combination with LAMMPS snapshots
<a href="#"><u>plotview.py</u></a>	Plot multiple vectors from a data set
<a href="#"><u>rasmol.py</u></a>	

	3d visualization via <u>RasMol</u> program
<u>raster.py</u>	3d visualization via <u>Raster3d</u> program
<u>svg.py</u>	3d visualization via <u>SVG</u> files
<u>vcr.py</u>	VCR-style GUI for 3d interactive OpenGL visualization
<u>vec.py</u>	Read columns of numbers from a file
<u>vtk.py</u>	Convert LAMMPS snapshots to VTK format
<u>xyz.py</u>	Convert LAMMPS snapshots to XYZ format

This diagram represents the different ways tools can be interconnected by Pizza.py. Tools within the same red box are tools that are (roughly) interchangeable.



## 5. Example scripts

The Pizza.py distribution includes 2 sets of example scripts. A listing of included scripts is given on the [Pizza.py WWW site](#).

(A) The examples directory has a README file and a variety of scripts. For each tool in Pizza.py there is a test\_tool.py script that invokes the tool on a simple data set (from the files sub-directory) and exercises various tool methods. These scripts are meant to illustrate how the tool is used.

Assuming pizza.py is in your path, each of the test scripts can be run from within the examples directory by typing one of these lines (from the shell or from within Pizza.py):

```
% pizza.py -f test_animate.py
> @run test_animate.py
```

The remaining scripts in the examples directory illustrate how to do various tasks in Pizza.py. They are not meant to be generically useful nor are they well documented. Rather they are illustrations of how to do some specific task quickly and straightforwardly. Most of these scripts are not meant to be run by other users, since their data files are not included.

(B) The scripts directory contains several scripts you may find useful either to use directly or to modify to create a new script for your purposes.

The top of each script file describes its purpose and syntax. That information can be accessed from within Pizza.py by typing "??" or "? name.py" or "?? name.py".

As explained in [this section](#), any file in the scripts directory can be run from the directory where your data lives, by typing a line appropriate to the script's syntax, e.g.

```
% pizza.py -f movie.py svg 60 135 dump.protein      from the shell
> @run movie.py svg 60 135 dump.protein             from Pizza.py
```

## 6. Extending Pizza.py

Pizza.py can easily be extended in several ways:

1. fix a bug
2. make a tool method faster or cleaner
3. add a new method or setting to a tool
4. add a new tool
5. add a generically useful script to the scripts dir
6. add a script that does something interesting to the examples dir
7. send a picture or movie you made with Pizza.py for the [WWW page](#).

You might be able to do (2) because you're better with Python than we are! Note that generally, we've opted for simplicity versus speed in writing the tools, unless the operation is very costly. An example of something I'd like to speed up is the reading of large dump files in dump.py.

Some of the ideas we've had for (3), but haven't gotten around to, are listed at the top of the src/\*.py files as ToDo items.

If you think your addition will be useful to other Pizza.py users, email it to [sjplimp@sandia.gov](mailto:sjplimp@sandia.gov) and it can be added to the distribution with an attribution to you, both in the source code and on the [Pizza.py WWW site](#).

---

Here are ideas to consider when creating new Pizza.py tools or scripts:

(1) For tools, your \*.py file should contain a Python class with the same name as the \*.py file since it will be imported into Pizza.py with a statement like

```
from dump import dump
```

(2) Your scripts can use methods from Pizza.py classes to make data analysis easier. E.g. scripts can be written that use the dump tool to read LAMMPS dump files, then use the iterator calls and vecs() method from dump.py to loop over snapshots and extract lists of atoms for further computation. See the scripts and examples directories for examples of this.

(3) To flag an error in your script or tool and exit back to the Pizza.py prompt, use a line like:

```
raise StandardError,"error message"
```

(4) Document your tool by defining the "oneline" and "docstr" variables at the top of the file. This is what will be printed when you type "? dump", for example.

(5) If you intend your tool to interact with other Pizza.py tools, you should follow the Pizza.py philosophy of having objects be passed as arguments to the tool methods. If you're creating a tool that is similar to an existing tool, but a different flavor (e.g. wrapping another plotting package in addition to MatLab or GnuPlot), then try to make the interface similar to the others so all the related tools can be used interchangeably.

(6) From the Pizza.py perspective, the difference between a script and a tool is as follows. A script typically does a specific operation (with or without arguments). E.g. process a dump file and compute a quantity. A tool version of the same operation would allow it to store internal state and persist, or to be packaged in a way that other tools or scripts can create instances of it and call its methods. From the Python perspective the code for the 2 cases may not look very different. The tool version might just be some Python variables and methods stuck inside a Python class, which is what a Pizza.py tool basically is.

(7) The various Pizza.py tools all are mostly related to the "LAMMPS" molecular dynamics package. Eventually new tools will be added for other software we distribute. But of course you can write Pizza.py tools that have nothing to do with LAMMPS. If you think they will still be of general interest to Pizza.py users, you can send them to us to include in the Pizza.py distribution. Or you can keep the top-level pizza.py file, throw away the LAMMPS tool files, build your own toolkit for whatever application you wish, and use or even distribute it yourself. That's the open-source philosophy.

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## animate tool

### Purpose:

Animate a series of image files.

### Description:

The animate tool displays a GUI to view and animate a series of image files.

The animate constructor creates the GUI. The animation can be controlled by the GUI widgets or by invoking the tool methods: play(), stop(), next(), etc. The frame slider can be dragged to view a desired frame.

Image files can be in any format (PNG, GIF, BMP, etc) recognized by the Python Image Library (PIL) installed in your Python. Various Pizza.py visualization tools (raster, rasmol, etc) create such image files. If a particular image format fails to load, your PIL installation was linked without support for that format. Rebuild PIL, and follow its install instructions.

### Usage:

```
a = animate("image*.png")      create GUI to animate set of image files
```

Actions (same as GUI widgets):

a.first()	go to first frame
a.prev()	go to previous frame
a.back()	play backwards from current frame to start
a.stop()	stop on current frame
a.play()	play from current frame to end
a.next()	go to next frame
a.last()	go to last frame
a.frame(31)	set frame slider
a.delay(0.4)	set delay slider

### Related tools:

[gl](#), [raster](#), [rasmol](#), [svg](#), [vcr](#)

### Prerequisites:

Python Tkinter and PIL packages.

[Pizza.py WWW Site](#) – [Pizza.py Documentation](#) – [Pizza.py Tools](#)

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## chain tool

### Purpose:

Create bead–spring chains for LAMMPS input.

### Description:

The chain tool creates random, overlapping bead–spring (FENE) chains and writes them out as a LAMMPS data file. They need to be simulated with a soft potential in LAMMPS to un–overlap them before they form a proper melt.

The chain constructor uses the total number of monomers and the Lennard–Jones reduced density to create a simulation box of the appropriate size. Optionally, the box shape can also be specified.

The build() method creates N chains, each with M monomers. It can be invoked multiple times to create sets of chains with different properties. The starting point of each chain is chosen randomly, as is the position of subsequent monomers. The seed value sets the random number generator used for coordinate generation.

The mtype, btype, blen, and dmin settings affect how the chain and its monomers are created. Dmin is the minimum distance allowed between a new monomer and the monomer two before it, so it determines the stiffness of the chain. Each monomer is assigned a molecule ID as it is created, in accord with the id setting.

Once N total monomers have been created, the ensemble of chains is written to a LAMMPS data file via the write() method.

### Usage:

```
c = chain(N,rho)           setup box with N monomers at reduced density rho
c = chain(N,rho,1,1,2)     x,y,z = aspect ratio of box (def = 1,1,1)

c.seed = 48379             set random # seed (def = 12345)
c.mtype = 2               set type of monomers (def =1)
c.btype = 1               set type of bonds (def = 1)
c.blen = 0.97             set length of bonds (def = 0.97)
c.dmin = 1.02             set min dist from i-1 to i+1 site (def = 1.02)

c.id = "chain"            set molecule ID to chain # (default)
c.id = "end1"            set molecule ID to count from one end of chain
c.id = "end2"            set molecule ID to count from either end of chain

c.build(100,10)           create 100 chains, each of length 10

    can be invoked multiple times interleaved with different settings
    must fill box with total of N monomers

c.write("data.file")      write out all built chains to LAMMPS data file
```

### Related tools:

[data\\_patch](#)

**Prerequisites:** none

[Pizza.py WWW Site](#) – [Pizza.py Documentation](#) – [Pizza.py Tools](#)

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## data tool

### Purpose:

Read, write, manipulate LAMMPS data files.

### Description:

The data tool reads and writes LAMMPS data files. It also allows their content to be accessed or modified.



The data constructor reads in the specified LAMMPS data file. With no argument, a blank file is created which can have fields added to it later.

The map() method assigns names to different atom attributes by their column number (1–N). The get() method extracts columns of information from the specified section of the data file.

The title, headers, and sections variables can be set directly. The header values correspond to one–line definition that appear at the top of the data file. The box size values should be set to a Python tuple, e.g.

```
d.headers["xlo xhi"] = (-30, 30)
```

The section value should be a list of text lines, each of which includes a newline at the end.

The delete() method deletes a header or entire section of the data file. The replace() method allows one column of a section to be replaced with a vector of new values. The newxyz() methods replaces the xyz coords of the "Atoms" section of the data file with xyz values from the Nth snapshot of a dump object containing snapshots.

The iterator() and viz() methods are called by Pizza.py tools that visualize snapshots of atoms (e.g. raster, svg tools). A data file snapshot can be visualized similarly to a dump file snapshot. In the case of a data file, there is only a single snapshot with index 0.

The write() method outputs a LAMMPS data file.

### Usage:

```
d = data("data.poly")      read a LAMMPS data file, can be gzipped
d = data()                 create an empty data file

d.map(1,"id",3,"x")        assign names to atom columns (1–N)

coeffs = d.get("Pair Coeffs")  extract info from data file section
q = d.get("Atoms",4)

    1 arg = all columns returned as 2d array of floats
    2 args = Nth column returned as vector of floats

d.title = "My LAMMPS data file"  set title of the data file
d.headers["atoms"] = 1500        set a header value
d.sections["Bonds"] = lines      set a section to list of lines (with newlines)
d.delete("bonds")               delete a keyword or section of data file
d.delete("Bonds")
d.replace("Atoms",5,vec)         replace Nth column of section with vector
d.newxyz(dmp,1000)              replace xyz in Atoms with xyz of snapshot N

    newxyz assumes id,x,y,z are defined in both data and dump files
    also replaces ix,iy,iz if they are defined

index,time,flag = d.iterator(0/1)  loop over single data file snapshot
time,box,atoms,bonds,tris = d.viz(index)  return list of viz objects

    iterator() and viz() are compatible with equivalent dump calls
    iterator() called with arg = 0 first time, with arg = 1 on subsequent calls
        index = timestep index within dump object (only 0 for data file)
        time = timestep value (only 0 for data file)
```

```

    flag = -1 when iteration is done, 1 otherwise
    viz() returns info for specified timestep index (must be 0)
    time = 0
    box = [xlo,ylo,zlo,xhi,yhi,zhi]
    atoms = id,type,x,y,z for each atom as 2d array
    bonds = id,type,x1,y1,z1,x2,y2,z2,t1,t2 for each bond as 2d array
        if bonds do not exist is just an empty list
    tris = empty list of triangles
    lines = empty list of lines

d.write("data.new")           write a LAMMPS data file

```

## Related tools:

[raster, svg](#)

**Prerequisites:** none

[Pizza.py WWW Site](#) – [Pizza.py Documentation](#) – [Pizza.py Tools](#)

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## dump tool

### Purpose:

Read, write, manipulate LAMMPS dump files and atom attributes.

### Description:

The dump tool reads one or more LAMMPS dump files, stores their contents as a series of snapshots with 2d arrays of atom attributes, and allows the values to be accessed and manipulated.

The constructor method is passed a string containing one or more dump filenames. They can be listed in any order since snapshots are sorted by timestep after they are read and duplicate snapshots (with the same time stamp) are deleted. If a 2nd argument is specified, the files are not immediately read, but snapshots can be read one-at-a-time by the next() method.

The map() method assigns names to columns of atom attributes. The tselect() methods select one or more snapshots by their time stamp. The delete() method deletes unselected timesteps so their memory is freed up. This can be useful to do when reading snapshots one-at-a-time for huge data sets. The aselect() methods selects atoms within selected snapshots. The write() and scatter() methods write selected snapshots and atoms to one or more files.

The scale(), unscale(), wrap(), unwrap(), and owrap() methods change the coordinates of all atoms with respect to the simulation box size. The sort() method sorts atoms within snapshots by their ID.

The set() method enables new or existing columns to be set to new values. The minmax() method sets a column to an integer value between the min and max values in another column; it can be used to create a color map. The clone() method copies that column values at one timestep to other timesteps on a per-atom basis.

The time(), atom(), and vecs() methods return time or atom data as vectors of values.

The `iterator()` and `viz()` methods are called by Pizza.py tools that visualize snapshots of atoms (e.g. raster, svg tools). You can also use the `iterator()` method in your scripts to loop over selected snapshots. The `atype` setting determines what atom column is returned as atom "type" by the `viz()` method. The `bonds()` method can be used to create a static list of bonds that are returned by the `viz()` method.

## Usage:

```
d = dump("dump.one")           read in one or more dump files
d = dump("dump.1 dump.2.gz")   can be gzipped
d = dump("dump.*")             wildcard expands to multiple files
d = dump("dump.*",0)           two args = store filenames, but don't read

incomplete and duplicate snapshots are deleted
if atoms have 5 or 8 columns, assign id,type,x,y,z (ix,iy,iz)
atoms will be unscaled if stored in files as scaled

time = d.next()                read next snapshot from dump files

used with 2-argument constructor to allow reading snapshots one-at-a-time
snapshot will be skipped only if another snapshot has same time stamp
return time stamp of snapshot read
return -1 if no snapshots left or last snapshot is incomplete
no column name assignment or unscaling is performed

d.map(1,"id",3,"x")            assign names to atom columns (1-N)

d.tselect.all()                select all timesteps
d.tselect.one(N)               select only timestep N
d.tselect.none()               deselect all timesteps
d.tselect.skip(M)              select every Mth step
d.tselect.test("$t >= 100 and $t <10000") select matching timesteps
d.delete()                     delete non-selected timesteps

selecting a timestep also selects all atoms in the timestep
skip() and test() only select from currently selected timesteps
test() uses a Python Boolean expression with $t for timestep value
Python comparison syntax: == != <> <= >= and or

d.aselect.all()                select all atoms in all steps
d.aselect.all(N)               select all atoms in one step
d.aselect.test("$id > 100 and $type == 2") select match atoms in all steps
d.aselect.test("$id > 100 and $type == 2",N) select matching atoms in one step

all() with no args selects atoms from currently selected timesteps
test() with one arg selects atoms from currently selected timesteps
test() sub-selects from currently selected atoms
test() uses a Python Boolean expression with $ for atom attributes
Python comparison syntax: == != <> <= >= and or
$name must end with a space

d.write("file")                write selected steps/atoms to dump file
d.scatter("tmp")                write selected steps/atoms to mutiple files

scatter() files are given timestep suffix: e.g. tmp.0, tmp.100, etc

d.scale()                      scale x,y,z to 0-1 for all timesteps
d.scale(100)                   scale atom coords for timestep N
d.unscale()                    unscale x,y,z to box size to all timesteps
```

d.unscale(1000)	unscale atom coords for timestep N
d.wrap()	wrap x,y,z into periodic box via ix,iy,iz
d.unwrap()	unwrap x,y,z out of box via ix,iy,iz
d.owrap("other")	wrap x,y,z to same image as another atom
d.sort()	sort atoms by atom ID in all selected steps
d.sort(1000)	sort atoms in timestep N

scale(), unscale(), wrap(), unwrap(), owrap() operate on all steps and atoms  
wrap(), unwrap(), owrap() require ix,iy,iz be defined  
owrap() requires a column be defined which contains an atom ID  
name of that column is the argument to owrap()  
x,y,z for each atom is wrapped to same image as the associated atom ID  
useful for wrapping all molecule's atoms the same so it is contiguous

m1,m2 = d.minmax("type")	find min/max values for a column
d.set("\$ke = \$vx * \$vx + \$vy * \$vy")	set a column to a computed value
d.spread("ke",N,"color")	2nd col = N ints spread over 1st col
d.clone(1000,"color")	clone timestep N values to other steps

minmax() operates on selected timesteps and atoms  
set() operates on selected timesteps and atoms  
left hand side column is created if necessary  
left-hand side column is unset or unchanged for non-selected atoms  
equation is in Python syntax  
use \$ for column names, \$name must end with a space  
spread() operates on selected timesteps and atoms  
min and max are found for 1st specified column across all selected atoms  
atom's value is linear mapping (1-N) between min and max  
that is stored in 2nd column (created if needed)  
useful for creating a color map  
clone() operates on selected timesteps and atoms  
values at every timestep are set to value at timestep N for that atom ID  
useful for propagating a color map

t = d.time()	return vector of selected timestep values
fx,fy,... = d.atom(100,"fx","fy",...)	return vector(s) for atom ID N
fx,fy,... = d.vecs(1000,"fx","fy",...)	return vector(s) for timestep N

atom() returns vectors with one value for each selected timestep  
vecs() returns vectors with one value for each selected atom in the timestep

index,time,flag = d.iterator(0/1)	loop over dump snapshots
time,box,atoms,bonds,tris = d.viz(index)	return list of viz objects
d.atype = "color"	set column returned as "type" by viz
d.extra("dump.bond")	read bond list from dump file
d.extra(data)	extract bond/tri/line list from data

iterator() loops over selected timesteps  
iterator() called with arg = 0 first time, with arg = 1 on subsequent calls  
index = index within dump object (0 to # of snapshots)  
time = timestep value  
flag = -1 when iteration is done, 1 otherwise  
viz() returns info for selected atoms for specified timestep index  
time = timestep value  
box = [xlo,ylo,zlo,xhi,yhi,zhi]  
atoms = id,type,x,y,z for each atom as 2d array  
bonds = id,type,x1,y1,z1,x2,y2,z2,t1,t2 for each bond as 2d array  
if bonds() was used to define bonds, else empty list  
tris = id,type,x1,y1,z1,x2,y2,z2,x3,y3,z3,nx,ny,nz for each tri as 2d array  
if extra() was used to define tris, else empty list  
lines = id,type,x1,y1,z1,x2,y2,z2 for each line as 2d array

```
    if extra() was used to define lines, else empty list
    atype is column name viz() will return as atom type (def = "type")
    extra() stores list of bonds/tris/lines to return each time viz() is called
```

### Related tools:

[data](#), [gl](#), [raster](#), [svg](#)

### Prerequisites:

Numeric Python package. Gunzip command (if you want to read gzipped files).

[Pizza.py WWW Site](#) – [Pizza.py Documentation](#) – [Pizza.py Tools](#)

---

## gl tool

### Purpose:

3d interactive visualization via OpenGL.

### Description:

The gl tool does visualizes LAMMPS snapshots or data files via OpenGL graphics calls. The interface to OpenGL is provided to Python by the open-source [PyOpenGL toolkit](#). To do interactive visualization, consider using this tool in conjunction with the [y-cr](#) tool.

The gl constructor takes a data object containing atom snapshots as an argument ([dump](#), [data](#)).

The show() method displays a single image of the selected atoms of snapshot N and saves it as image.png. While an image is displayed, the view can be changed directly by using the mouse buttons in the OpenGL window to translate (left), rotate (middle), or zoom (right) the image. However, these mouse changes are not permanent, unless the corresponding trans(), rotate(), and zoom() methods are invoked. The all() method loops thru all selected snapshots, displaying each one in turn. The resulting image files are saved to image0000.png, image0001.png, etc. The prefix "image" can be changed via the file setting.

The bg(), size(), rotate(), trans(), zoom(), box(), label(), and nlabel() methods control various aspects of the images produced. Without the trans() and zoom() settings, the GL image should roughly fill the window and be centered.

Additional movie effects can be produced using the pan() and select() methods. The pan() method specifies an initial and final viewpoint that is applied to the images produced by the all() method. For intermediate images, the view parameters will be interpolated between their initial and final values. The pan() method can thus be used to rotate a single image or fly-by the simulation as it animates. The select() method performs additional atom selection for each image of the all() sequence. An image-dependent %g variable can be used in the select() string. The select() method can thus be used to slice thru the data set.

The acol(), arad(), bcol(), brad(), tcol(), and tfill() methods change attributes of the atoms, bonds, and triangles displayed. Each atom or bond returned from the data object has an integer "type" from 1 to N. The type is used to index into a list of RGB colors or radii for atoms and bond thickness. The adef(), bdef(), and tdef() methods setup default mappings of types to colors/radii. The other methods enable specific assignments to be made. The interpolation option (e.g. many types assigned to a few colors), enables a smooth rainbow of colors

to be assigned to a range of types. Note that the [dump](#) tool allows any vector to be returned as an atom "type" via its atype setting. Thus displayed colors can be keyed to atom velocity or other properties.

Colors are specified with a string, e.g. "red". There are 140 pre-defined colors from [this WWW page](#) which can be examined by importing the "colors" variable from "vizinfo". New colors can be defined by assigning a nickname of your choice to an RGB triplet, as described below.

The visual quality of atom spheres can be set via the q() method. The axis() method toggles whether xyz axes are displayed in the OpenGL window. Red is the +x axis, green is +y, and blue is +z. The ortho() method toggles between an orthographic and perspective display of the snapshot. The clip() method can be used to narrow the amount of data that is visualized. The reload() method is needed if you change the selection attributes of the underlying data assigned to the [gl](#) tool, such as via the [dump](#) tool's methods. These changes will not be visible in the OpenGL window until the data is reloaded.

### Usage:

```
g = gl(d)                                create OpenGL display for data in d

d = atom snapshot object (dump, data)

g.bg("black")                            set background color (def = "black")
g.size(N)                                set image size to NxN
g.size(N,M)                              set image size to NxM
g.rotate(60,135)                          view from z theta and azimuthal phi (def = 60,30)
g.shift(x,y)                             translate by x,y pixels in view window (def = 0,0)
g.zoom(0.5)                              scale image by factor (def = 1)
g.box(0/1/2)                             0/1/2 = none/variable/fixed box
g.box(0/1/2,"green")                     set box color
g.box(0/1/2,"red",4)                     set box edge thickness
g.file = "image"                         file prefix for created images (def = "image")

g.show(N)                                show image of snapshot at timestep N

g.all()                                  make images of all selected snapshots
g.all(P)                                 images of all, start file label at P
g.all(N,M,P)                             make M images of snapshot N, start label at P

g.pan(60,135,1.0,40,135,1.5)             pan during all() operation
g.pan()                                  no pan during all() (default)

args = z theta, azimuthal phi, zoom factor at beginning and end
values at each step are interpolated between beginning and end values

g.select = "$x > %g*3.0"                 string to pass to d.aselect.test() during all()
g.select = ""                             no extra aselect (default)

%g varies from 0.0 to 1.0 from beginning to end of all()

g.acol(2,"green")                         set atom colors by atom type (1-N)
g.acol([2,4],["red","blue"])             1st arg = one type or list of types
g.acol(0,"blue")                          2nd arg = one color or list of colors
g.acol(range(20),["red","blue"])         if list lengths unequal, interpolate
g.acol(range(10),"loop")                 assign colors in loop, randomly ordered

if 1st arg is 0, set all types to 2nd arg
if list of types has a 0 (e.g. range(10)), +1 is added to each value
```

interpolate means colors blend smoothly from one value to the next

<code>g.arad([1,2],[0.5,0.3])</code>	set atom radii, same rules as <code>acol()</code>
<code>g.bcol()</code>	set bond color, same args as <code>acol()</code>
<code>g.brad()</code>	set bond thickness, same args as <code>arad()</code>
<code>g.tcol()</code>	set triangle color, same args as <code>acol()</code>
<code>g.tfill()</code>	set triangle fill, 0 fill, 1 line, 2 both
<code>g.lcol()</code>	set line color, same args as <code>acol()</code>
<code>g.adeb()</code>	set atom/bond/tri/line properties to default
<code>g.bdeb()</code>	default = "loop" for colors, 0.45 for radii
<code>g.tdeb()</code>	default = 0.25 for bond thickness, 0 fill
<code>g.ldeb()</code>	

by default, 100 types are assigned

if an atom/bond/tri/line has type > # defined properties, it becomes type = 1

<code>from vizinfo import colors</code>	access color list
<code>print colors</code>	list defined color names and RGB values
<code>colors["nickname"] = [R,G,B]</code>	set new RGB values from 0 to 255

140 pre-defined colors: red, green, blue, purple, yellow, black, white, etc

Settings specific to gl tool:

<code>g.q(10)</code>	set quality of image (def = 5)
<code>g.axis(0/1)</code>	turn xyz axes off/on
<code>g.ortho(0/1)</code>	perspective (0) vs orthographic (1) view
<code>g.clip('xlo',0.25)</code>	clip in xyz from lo/hi at box fraction (0-1)
<code>g.reload()</code>	force all data to be reloaded
<code>g.cache = 0/1</code>	turn off/on GL cache lists (def = on)

data reload is necessary if dump selection is used to change the data  
cache lists usually improve graphics performance

## Related tools:

[dump](#), [rasmol](#), [raster](#), [svg](#), [vcr](#),

## Prerequisites:

Python PyOpenGL and PIL packages.

[Pizza.py WWW Site](#) – [Pizza.py Documentation](#) – [Pizza.py Tools](#)

---

## gnu tool

### Purpose:

Create plots via GnuPlot plotting program.

### Description:

gnu tool

The gnu tool is a wrapper on the GnuPlot plotting package. GnuPlot is open source software and runs on any platform.

The gnu constructor launches GnuPlot as a process which the gnu tool sends commands to. The GnuPlot process can be killed via the stop() method, though this is typically unnecessary.

The plot() method plots a single vector against a linear index or pairs of vectors against each other. The pairs of vectors are written to files and read-in by GnuPlot's plot command.

The mplot() method creates a series of plots and saves them each to a numbered file. Each file is a plot of an increasing portion of the vector(s). This can be used to make an animation of a plot.

The enter() method can be used to interact with GnuPlot directly. Each subsequent line you type is a GnuPlot command, until you type "quit" or "exit" to return to Pizza.py. Single GnuPlot commands can be issued as string arguments to the gnu tool.

The export() method writes numeric data as columns to text files, so that GnuPlot can read them via its "plot" command.

Multiple windows can be displayed, plotted to, and manipulated using the select() and hide() methods. The save() method writes the currently selected plot to a PostScript file.

The remaining methods (aspect, title, xrange, etc) set attributes of the currently selected plot. The erase() method resets all attributes to their default values.

### Usage:

```
g = gnu()                start up GnuPlot
g.stop()                 shut down GnuPlot process

g.plot(a)                 plot vector A against linear index
g.plot(a,b)               plot B against A
g.plot(a,b,c,d,...)       plot B against A, D against C, etc
g.mplot(M,N,S,"file",a,b,...) multiple plots saved to file0000.eps, etc

    each plot argument can be a tuple, list, or Numeric vector
    mplot loops over range(M,N,S) and create one plot per iteration
    last args are same as list of vectors for plot(), e.g. 1, 2, 4 vectors
    each plot is made from a portion of the vectors, depending on loop index i
    i-th plot is of b[0:i] vs a[0:i], etc
    series of plots saved as file0000.eps, file0001.eps, etc
    if use xrange(),yrange() then plot axes will be same for all plots

g("plot 'file.dat' using 2:3 with lines")    execute string in GnuPlot

g.enter()                enter GnuPlot shell
gnuplot> plot sin(x) with lines               type commands directly to GnuPlot
gnuplot> exit, quit       exit GnuPlot shell

g.export("data",range(100),a,...)             create file with columns of numbers

    all vectors must be of equal length
    could plot from file with GnuPlot command: plot 'data' using 1:2 with lines

g.select(N)                figure N becomes the current plot
```



subsequent commands apply to this plot

<code>g.hide(N)</code>	delete window for figure N
<code>g.save("file")</code>	save current plot as file.eps

Set attributes for current plot:

<code>g.erase()</code>	reset all attributes to default values
<code>g.aspect(1.3)</code>	aspect ratio
<code>g.xtitle("Time")</code>	x axis text
<code>g.ytitle("Energy")</code>	y axis text
<code>g.title("My Plot")</code>	title text
<code>g.title("title", "x", "y")</code>	title, x axis, y axis text
<code>g.xrange(xmin, xmax)</code>	x axis range
<code>g.xrange()</code>	default x axis range
<code>g.yrange(ymin, ymax)</code>	y axis range
<code>g.yrange()</code>	default y axis range
<code>g.xlog()</code>	toggle x axis between linear and log
<code>g.ylog()</code>	toggle y axis between linear and log
<code>g.label(x, y, "text")</code>	place label at x, y coords
<code>g.curve(N, 'r')</code>	set color of curve N

colors: 'k' = black, 'r' = red, 'g' = green, 'b' = blue  
'm' = magenta, 'c' = cyan, 'y' = yellow

## Related tools:

[matlab, plotview](#)

## Prerequisites:

GnuPlot plotting package.

[Pizza.py WWW Site](#) – [Pizza.py Documentation](#) – [Pizza.py Tools](#)

---

## image tool

### Purpose:

View and manipulate images.

### Description:

The image tool can be used to display image files or convert them to other formats via the ImageMagick tools (or alternate tools if specified in the DEFAULTS.py file).

The image constructor creates a GUI to view a set of image files as a palette of thumbnail-size images. Each thumbnail can be clicked on to view the full-size image. Clicking on the full-size image removes it. The view() method does the same operation for a new set of files.

The convert() method invokes the ImageMagick "convert" command to convert an image file to a different format. If both arguments have a wildcard character, one conversion is done for each file in the 1st argument to create a file in the 2nd argument, e.g. "convert image0012.svg new0012.png". If either argument has no wildcard, one "convert" command is issued using both arguments. This form can be used to create a movie

file, e.g. "convert \*.png ligand.mpg".

The montage() method invokes the ImageMagick "montage" command to combine 2 image files to create a 3rd. If all 3 arguments have a wildcard character, one montage is created for each file in the 1st argument, paired with one file in the 2nd argument, e.g. "montage image0012.svg plot0012.eps combine0012.png". For this to work, the 1st arguments must each expand to the same number of files. If any of the 3 arguments does not have a wildcard, one "montage" command is issued using all 3 arguments.

Image files can be in any format (PNG, GIF, JPG, etc) recognized by the Python Image Library (PIL) installed in your Python or by ImageMagick. Various Pizza.py visualization tools (raster, deja, rasmol, etc) create such image files. If a particular image format fails to load, your PIL installation was linked without support for that format. Rebuild PIL, and follow the install instructions included in its top directory.

### Usage:

```
i = image("my1.gif my2.gif")    display thumbnails of matching images
i = image("*.png *.gif")        wildcards allowed
i = image("")                    blank string matches all image suffixes
i = image()                     no display window opened if no arg

image suffixes for blank string = *.png, *.bmp, *.gif, *.tiff, *.tif
click on a thumbnail to view it full-size
click on thumbnail again to remove full-sized version

i.view("*.png *.gif")           display thumbnails of matching images

view arg is same as constructor arg

i.convert("image*.svg","new*.png")    each SVG file to PNG
i.convert("image*.svg","new*.jpg",-quality 50)  3rd arg is switch
i.convert("image*.png","movie.mpg")    all PNGs to MPG movie
i.convert("image*.png","movie.mpg",-resize 128x128)  3rd arg is switch
i.montage("", "image*.png", "plot*.png", "two*.png")  image + plot = two
i.montage("-geometry 512x512", "i*.png", "new.png")  1st arg is switch

convert with 2 wildcard args loops over 1st set of files to make 2nd set
convert with not all wildcard args will issue single convert command
montage with all wildcard args loops over 1st set of files,
    combines with one file from other sets, to make last set of files
montage with not all wildcard args will issue single montage command
```

### Related tools:

[raster](#), [rasmol](#), [animate](#)

### Prerequisites:

Python Tkinter, Pmw, and PIL packages. ImageMagick convert and montage commands or equivalent.

[Pizza.py WWW Site](#) – [Pizza.py Documentation](#) – [Pizza.py Tools](#)

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# log tool

## Purpose:

Read LAMMPS log files and extract thermodynamic data.

## Description:

Read one or more LAMMPS log files and combine their thermodynamic data into long, named vectors (versus time). The vectors can be used in Python for further processing and plotting, or they can be output to a file.

The log constructor reads one or more log files. If 2 arguments are specified, a single file is specified, and it can be read incrementally (e.g. as it is created) by the next() method.

The nvec, nlen, and names values give the # of vectors, their length, and names. The get() method returns one of more vectors as a Python list. The write() method outputs the numeric vectors to a file.

## Usage:

```
l = log("file1")           read in one or more log files
l = log("log1 log2.gz")    can be gzipped
l = log("file*")           wildcard expands to multiple files
l = log("log.lammps",0)    two args = store filename, but don't read
```

incomplete and duplicate thermo entries are deleted

```
time = l.next()            read new thermo info from file
```

used with 2-argument constructor to allow reading thermo incrementally  
return time stamp of last thermo read  
return -1 if no new thermo since last read

```
nvec = l.nvec              # of vectors of thermo info
nlen = l.nlen              length of each vectors
names = l.names            list of vector names
t,pe,... = l.get("Time","KE",...) return one or more vectors of values
l.write("file.txt")        write all vectors to a file
l.write("file.txt","Time","PE",...) write listed vectors to a file
```

get and write allow abbreviated (uniquely) vector names

## Related tools:

[plotview](#), [gnu](#), [matlab](#)

**Prerequisites:** none

[Pizza.py WWW Site](#) – [Pizza.py Documentation](#) – [Pizza.py Tools](#)

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# matlab tool

## Purpose:

Create plots via MatLab numerical analysis program.

## Description:

The matlab tool is a wrapper on the MatLab numerical analysis package, primarily designed to use its plotting capabilities. MatLab is commercial software available on a variety of platforms.

The matlab constructor launches MatLab as a process which the matlab tool sends commands to. The MatLab process can be killed via the stop() method, though this is typically unnecessary.

The plot() method plots a single vector against a linear index or pairs of vectors against each other. The pairs of vectors are written to files and read-in by MatLab. The Nth curve in a plot is stored in the MatLab variable pizzaN, so the 2 vectors can be accessed within MatLab as pizzaN(:,1) and pizzaN(:,2).

The mplot() method creates a series of plots and saves them each to a numbered file. Each file is a plot of an increasing portion of the vector(s). This can be used to make an animation of a plot.

The enter() method can be used to interact with MatLab directly. Each subsequent line you type is a MatLab command, until you type "quit" or "exit" to return to Pizza.py. Single MatLab commands can be issued as string arguments to the gnu tool.

The export() method writes numeric data as columns to text files, so that MatLab can read them via its "importdata" command.

Multiple windows can be displayed, plotted to, and manipulated using the select() and hide() methods. The save() method writes the currently selected plot to a PostScript file.

The remaining methods (aspect, title, xrange, etc) set attributes of the currently selected plot. The erase() method resets all attributes to their default values.

## Usage:

```
m = matlab()           start up MatLab
m.stop()               shut down MatLab process

m.plot(a)              plot vector A against linear index
m.plot(a,b)            plot B against A
m.plot(a,b,c,d,...)    plot B against A, D against C, etc
m.mplot(M,N,S,"file",a,b,...) multiple plots saved to file0000.eps, etc

each plot argument can be a tuple, list, or Numeric vector
mplot loops over range(M,N,S) and create one plot per iteration
  last args are same as list of vectors for plot(), e.g. 1, 2, 4 vectors
  each plot is made from a portion of the vectors, depending on loop index i
    Ith plot is of b[0:i] vs a[0:i], etc
  series of plots saved as file0000.eps, file0001.eps, etc
  if use xrange(),yrange() then plot axes will be same for all plots

m("c = a + b")         execute string in MatLab
```

```

m.enter()                enter MatLab shell
matlab> c = a + b        type commands directly to MatLab
matlab> exit, quit       exit MatLab shell

m.export("data",range(100),a,...)    create file with columns of numbers

all vectors must be of equal length
could plot from file with MatLab commands:
    cols = importdata('data')
    plot(cols(:,1),cols(:,2))

m.select(N)              figure N becomes the current plot

subsequent commands apply to this plot

m.hide(N)                delete window for figure N
m.save("file")           save current plot as file.eps

Set attributes for current plot:

m.erase()               reset all attributes to default values
m.aspect(1.3)           aspect ratio
m.xtitle("Time")         x axis text
m.ytitle("Energy")       y axis text
m.title("My Plot")       title text
m.title("title","x","y") title, x axis, y axis text
m.xrange(xmin,xmax)     x axis range
m.xrange()              default x axis range
m.yrange(ymin,ymax)     y axis range
m.yrange()              default y axis range
m.xlog()                toggle x axis between linear and log
m.ylog()                toggle y axis between linear and log
m.label(x,y,"text")     place label at x,y coords
m.curve(N,'r')           set color of curve N
m.curve(N,'g','--')      set color and line style of curve N
m.curve(N,'b','-','v')   set color, line style, symbol of curve N

colors:  'k' = black, 'r' = red, 'g' = green, 'b' = blue
         'm' = magenta, 'c' = cyan, 'y' = yellow
styles:  '-' = solid, '--' = dashed, ':' = dotted, '-.' = dash-dot
symbols: '+' = plus, 'o' = circle, '*' = asterik, 'x' = X,
         's' = square, 'd' = diamond, '^' = up triangle,
         'v' = down triangle, '>' = right triangle,
         ,

```

## Related tools:

[gnu. plotview](#)

## Prerequisites:

The MatLab numerical analysis package.

[Pizza.py WWW Site](#) – [Pizza.py Documentation](#) – [Pizza.py Tools](#)

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# pair tool

## Purpose:

Compute LAMMPS pairwise energies.

## Description:

The pair tool computes a pairwise energy between 2 particles using a LAMMPS molecular dynamics force field. Thus it can be used in an analysis script to compute energies between groups of atoms from a LAMMPS snapshot file.

The pair constructor specifies the force field style. Only some of the LAMMPS pair styles are currently included in this tool, but new styles can easily be added. Code from the LAMMPS pair\*.cpp file needs to be re-coded in Python to make this work.

The coeff() method reads the pairwise coefficients for the force field from a data file object (see the [data](#) tool). The init() method does pre-computations for the force field parameters needed by the single() method which does a pairwise computation between two atoms of type = itype,jtype separated by a squared distance rsq. The arguments for init() and single() can be different for a particular force field style. When you write the init() and single() methods for a new style, you can define what arguments are needed.

## Usage:

```
p = pair("lj/charmm/coul/charmm")    create pair object for specific pair style
```

```
available styles: lj/cut, lj/cut/coul/cut, lj/charmm/coul/charmm
```

```
p.coeff(d)                        extract pairwise coeffs from data object
p.init(cut1,cut2,...)             setup based on coeffs and cutoffs
```

```
init args are specific to pair style:
```

```
lj/cut = cutlj
lj/cut/coul/cut = cutlj,cut_coul (cut_coul optional)
lj/charmm/coul/charmm = cutlj_inner,cutlj,cutcoul_inner,cut_coul
                        (last 2 optional)
```

```
e_vdwl,e_coul = p.single(rsq,itype,jtype,q1,q2,...)    compute LJ/Coul energy
```

```
pairwise energy between 2 atoms at distance rsq with their attributes
args are specific to pair style:
```

```
lj/cut = rsq,itype,jtype
lj/cut/coul/cut = rsq,itype,jtype,q1,q2
lj/charmm/coul/charmm = rsq,itype,jtype,q1,q2
```

## Related tools:

[data](#)

**Prerequisites:** none

[Pizza.py WWW Site](#) – [Pizza.py Documentation](#) – [Pizza.py Tools](#)

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## patch tool

### Purpose:

Create patchy Lennard–Jones particles for LAMMPS input.

### Description:

The patch tool creates large multi–atom particles and writes them out as a LAMMPS data file. They need to be simulated with a soft potential in LAMMPS to un–overlap them before they form a proper ensemble.

The individual particles consist of a collection of Lennard–Jones atoms of various types. By defining force field coefficients appropriately, specific atoms can be made attractive or repulsive, so that "patches" of atoms on the particle surface are reactive. The [Pizza.py WWW site](#) has example images and movies of simulations using such particles. A [paper](#) by [Sharon Glotzer's group](#) at U Michigan describing a variety of patchy particle models was the motivation for this tool.

The patch constructor takes a volume fraction as an argument to determine how densely to fill the simulation box. Optionally, the box shape can also be specified.

The build() method creates N particles, each of specified style and with specified atom types. Several styles are available and new ones can easily be added to patch.py. You will need to look in patch.py for the details of what each style represents. For example, "hex2" uses a C60 bucky ball as a template and creates hexagonal 6–atom patches (atoms of a different type) on either side of the ball.

The build() method can be invoked multiple times to create collections of particles. The position and orientation of each particle is chosen randomly. The seed value sets the random number generator used for coordinate generation.

The ensemble of chains is written to a LAMMPS data file via the write() method.

### Usage:

```
p = patch(vfrac)           setup box with a specified volume fraction
p = patch(vfrac,1,1,2)     x,y,z = aspect ratio of box (def = 1,1,1)

p.seed = 48379             set random # seed (def = 12345)

p.build(100,"hex2",1,2,3)  create 100 "hex2" particles with types 1,2,3

    can be invoked multiple times
    particle styles = "hex2", "ring", "tri5"
    args following style are passed to style method

p.write("data.patch")      write out system to LAMMPS data file
```

### Related tools:

[chain\\_data](#)

**Prerequisites:** none

---

## pdb tool

### Purpose:

Read, write PDB files in combination with LAMMPS snapshots.

### Description:

The `pdb` tool reads in PDB (Protein Data Bank) files of protein coordinates and uses them in conjunction with LAMMPS snapshots in various ways. The PDB format is commonly used by various visualization and analysis programs.

The `pdb` constructor takes a string argument listing one or more PDB filenames and a data argument with LAMMPS atom information (`data` or `dump` object). Both arguments are optional, as described below. If a single PDB file is given as a constructor argument, and it is 4 letters long, and it does not exist on your system, then it is treated as a PDB identifier and the matching PDB file is downloaded from a PDB repository on the WWW to your machine.

The `one()`, `many()`, and `single()` methods write out PDB files in various manners, depending on the 1 or 2 arguments used in the constructor. If only a string was specified (no data object), the specified PDB files are written out as-is. Thus the `one()` method concatenates the files together. If only a data object was specified (no string of PDB files), then PDB files in a generic format (Lennard–Jones atoms) are created. If both arguments are specified, then only a single PDB file can be listed. It is treated as a template file, and the atom coordinates in the data object replace the atom coordinates in the template PDB file to create a series of new PDB files. This replacement is only done for selected atoms (in the `dump` object) and for atom IDs that appear in the PDB file.

The `iterator()` method is called by the `rasmol` tool to create a series of PDB files for visualization purposes.

### Usage:

```
p = pdb("3CRO")           create pdb object from PDB file or WWW
p = pdb("pep1 pep2")      read in multiple PDB files
p = pdb("pep*")           can use wildcards
p = pdb(d)                read in snapshot data with no PDB file
p = pdb("3CRO",d)         read in single PDB file with snapshot data

string arg contains one or more PDB files
    don't need .pdb suffix except wildcard must expand to file.pdb
    if only one 4-char file specified and it is not found,
        it will be downloaded from http://www.rcsb.org as 3CRO.pdb
d arg is object with atom coordinates (dump, data)

p.one()                   write all output as one big PDB file to tmp.pdb
p.one("mine")             write to mine.pdb
p.many()                  write one PDB file per snapshot: tmp0000.pdb, ...
p.many("mine")            write as mine0000.pdb, mine0001.pdb, ...
p.single(N)               write timestamp N as tmp.pdb
p.single(N,"new")         write as new.pdb
```



```

how new PDB files are created depends on constructor inputs:
  if no d: one new PDB file for each file in string arg (just a copy)
  if only d specified: one new PDB file per snapshot in generic format
  if one file in str arg and d: one new PDB file per snapshot
    using input PDB file as template
  multiple input PDB files with a d is not allowed

```

```

index,time,flag = p.iterator(0)
index,time,flag = p.iterator(1)

```

```

iterator = loop over number of PDB files
  call first time with arg = 0, thereafter with arg = 1
  N = length = # of snapshots or # of input PDB files
  index = index of snapshot or input PDB file (0 to N-1)
  time = timestep value (time stamp for snapshot, index for multiple PDB)
  flag = -1 when iteration is done, 1 otherwise
  typically call p.single(time) in iterated loop to write out one PDB file

```

### Related tools:

[data](#), [dump](#), [rasmol](#)

**Prerequisites:** none

[Pizza.py WWW Site](#) – [Pizza.py Documentation](#) – [Pizza.py Tools](#)

---

## plotview tool

### Purpose:

Plot multiple vectors from a data set.

### Description:

The plotview tool displays a GUI for showing a series of plots of vectors stored in another Pizza.py tool. Individual plots can be displayed or hidden or saved to a file.

The plotview constructor creates the GUI and takes a data object ([log](#), [vec](#)) and a plot object ([gnu](#), [matlab](#)) as arguments.

The vectors in the data object are converted to individual plots. The 2nd thru Nth vectors are each plotted against the 1st vector to create N–1 plots. One or more plots can be displayed simultaneously (right buttons in GUI), but only one is selected at a time (left buttons in GUI). The `yes()`, `no()`, and `select()` methods perform the same function as the GUI buttons.

The currently selected plot can be modified (title, range, etc) by the methods of the plot object.

The `file()` and `save()` methods (or corresponding GUI widgets) save the currently selected plot to a PostScript file.

### Usage:

```
p = plotview(d,p)          create GUI for viewing plots
```

```

d = Pizza.py object that contains vectors (log, vec)
p = Pizza.py plotting object (gnu, matlab)

p.select(2)          select one plot as current (1-N)
p.yes(3)             toggle one plot's visibility
p.no(3)

only one plot is selected at a time
multiple plots can be visible at same time
select is same as clicking on left-side radio-button
yes/no is same as clicking on right-side checkbox

p.file("pressure")   filename prefix for saving a plot
p.save()             save currently selected plot to file.eps

```

### Related tools:

[log, gnu, matlab](#)

### Prerequisites:

Python Tkinter package.

[Pizza.py WWW Site](#) – [Pizza.py Documentation](#) – [Pizza.py Tools](#)

---

## rasmol tool

### Purpose:

3d visualization via RasMol program.

### Description:

The rasmol tool is a wrapper on the [RasMol](#) visualization program. RasMol is open source software and runs on many platforms. The link above is for the Open RasMol WWW site, not the Protein Explorer WWW site. Protein Explorer is a derivative of RasMol and runs primarily on Windows machines within a browser. This Pizza.py tool wraps the original RasMol program, not Protein Explorer.

The rasmol constructor takes a [pdb](#) object as its argument which produces PDB files that RasMol reads in. The pdb object can produce PDB files from a LAMMPS dump or data file, as well as in other ways.

The show() method runs RasMol on the atoms of snapshot N (converted to a PDB file) and displays the resulting image stored as image.gif. Either a default RasMol script or one you specify is used to format the RasMol image. The all() method loops thru all selected snapshots and runs RasMol on each one. The resulting image files are saved to image0000.gif, image0001.gif, etc. The prefix "image" can be changed via the file setting.

A RasMol script can be created by running RasMol itself (outside of Pizza.py), typing commands or choosing menu options to format the display as desired, then typing "write script filename". Alternatively the run() method will do this for you. It runs RasMol on snapshot N and lets you interact with RasMol directly either via typing or mouse operations in the RasMol window. When you type "quit" or "exit" the script file will be saved (do not exit via the Rasmol menu).

## Usage:

```
r = rasmol(p)           create RasMol wrapper for pdb object p

r.file = "image"        file prefix for created images (def = "image")

r.show(N)               show snapshot at timestep N with default script
r.show(N,"my.rasmol")   use file as RasMol script

r.all()                 make images of all selected snapshots with def script
r.all("my.rasmol")      use file as RasMol script

r.run(N)                run RasMol interactively on snapshot N
r.run(N,"new.rasmol")   adjust via mouse or RasMol commands
r.run(N,"new.rasmol","old.rasmol") type quit to save RasMol script file

    if 2 args, 2nd arg is new script file, else save to "tmp.rasmol"
    if 3 args, 3rd arg is initial script file, else use default script
```

## Related tools:

[dump](#), [gl](#), [pdb](#), [raster](#), [svg](#)

## Prerequisites:

The RasMol program.

[Pizza.py WWW Site](#) – [Pizza.py Documentation](#) – [Pizza.py Tools](#)

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## raster tool

### Purpose:

3d visualization via Raster3d program.

### Description:

The raster tool is a wrapper on the [Raster3d](#) visualization program. Raster3d is open source software and runs on many platforms.

The raster constructor takes a data object containing atom snapshots as an argument ([dump](#), [data](#)).

The show() method runs Raster3d on the selected atoms of snapshot N and displays the resulting image stored as image.png. The all() method loops thru all selected snapshots and runs Raster3d on each one. The resulting image files are saved to image0000.png, image0001.png, etc. The prefix "image" can be changed via the file setting.

The bg(), size(), rotate(), trans(), zoom(), box(), label(), and nolabel() methods control various aspects of the images produced. Without the trans() and zoom() settings, the Raster3d image should roughly fill the window and be centered.

Additional movie effects can be produced using the pan() and select() methods. The pan() method specifies an

initial and final viewpoint that is applied to the images produced by the `all()` method. For intermediate images, the view parameters will be interpolated between their initial and final values. The `pan()` method can thus be used to rotate a single image or fly-by the simulation as it animates. The `select()` method performs additional atom selection for each image of the `all()` sequence. An image-dependent %g variable can be used in the `select()` string. The `select()` method can thus be used to slice thru the data set.

The `acol()`, `arad()`, `bcoll()`, `brad()`, and `tcoll()` methods change attributes of the atoms, bonds, and triangles displayed. Each atom or bond returned from the data object has an integer "type" from 1 to N. The type is used to index into a list of RGB colors or radii for atoms and bond thickness. The `adef()`, `bdef()`, and `tdef()` methods setup default mappings of types to colors/radii. The other methods enable specific assignments to be made. The interpolation option (e.g. many types assigned to a few colors), enables a smooth rainbow of colors to be assigned to a range of types. Note that the [dump](#) tool allows any vector to be returned as an atom "type" via its `atype` setting. Thus displayed colors can be keyed to atom velocity or other properties.

Colors are specified with a string, e.g. "red". There are 140 pre-defined colors from [this WWW page](#) which can be examined by importing the "colors" variable from "vizinfo". New colors can be defined by assigning a nickname of your choice to an RGB triplet, as described below.

### Usage:

```
r = raster(d)                create Raster3d wrapper for data in d

d = atom snapshot object (dump, data)

r.bg("black")                set background color (def = "black")
r.size(N)                    set image size to NxN
r.size(N,M)                  set image size to NxM
r.rotate(60,135)              view from z theta and azimuthal phi (def = 60,30)
r.shift(x,y)                  translate by x,y pixels in view window (def = 0,0)
r.zoom(0.5)                   scale image by factor (def = 1)
r.box(0/1/2)                  0/1/2 = none/variable/fixed box
r.box(0/1/2,"green")          set box color
r.box(0/1/2,"red",4)          set box edge thickness
r.file = "image"              file prefix for created images (def = "image")

r.show(N)                     show image of snapshot at timestep N

r.all()                       make images of all selected snapshots
r.all(P)                      images of all, start file label at P
r.all(N,M,P)                  make M images of snapshot N, start label at P

r.pan(60,135,1.0,40,135,1.5)  pan during all() operation
r.pan()                       no pan during all() (default)

args = z theta, azimuthal phi, zoom factor at beginning and end
values at each step are interpolated between beginning and end values

r.select = "$x > %g*3.0"      string to pass to d.aselect.test() during all()
r.select = ""                  no extra aselect (default)

%g varies from 0.0 to 1.0 from beginning to end of all()

r.label(x,y,"h",size,"red","This is a label")  add label to each image
r.nolabel()                                     delete all labels

x,y coords = -0.5 to 0.5, "h" or "t" for Helvetica or Times font
```

```

size = fontsize (e.g. 10), "red" = color of text

r.acol(2,"green")           set atom colors by atom type (1-N)
r.acol([2,4],["red","blue"]) 1st arg = one type or list of types
r.acol(0,"blue")           2nd arg = one color or list of colors
r.acol(range(20),["red","blue"]) if list lengths unequal, interpolate
r.acol(range(10),"loop")    assign colors in loop, randomly ordered

    if 1st arg is 0, set all types to 2nd arg
    if list of types has a 0 (e.g. range(10)), +1 is added to each value
    interpolate means colors blend smoothly from one value to the next

r.arad([1,2],[0.5,0.3])    set atom radii, same rules as acol()

r.bcol()                   set bond color, same args as acol()
r.brad()                   set bond thickness, same args as arad()

r.tcol()                   set triangle color, same args as acol()
r.tfill()                  set triangle fill, 0 fill, 1 line, 2 both

r.lcol()                   set line color, same args as acol()

r.adeb()                   set atom/bond/tri/line properties to default
r.bdeb()                   default = "loop" for colors, 0.45 for radii
r.tdeb()                   default = 0.25 for bond thickness, 0 fill
r.ldeb()

    by default, 100 types are assigned
    if an atom/bond/tri/line has type > # defined properties, it becomes type = 1

from vizinfo import colors    access color list
print colors                  list defined color names and RGB values
colors["nickname"] = [R,G,B]  set new RGB values from 0 to 255

140 pre-defined colors: red, green, blue, purple, yellow, black, white, etc

```

## Related tools:

[dump](#), [gl](#), [rasmol](#), [svg](#)

## Prerequisites:

The Raster3d render and label3d programs.

[Pizza.py WWW Site](#) – [Pizza.py Documentation](#) – [Pizza.py Tools](#)

---

## svg tool

### Purpose:

3d visualization via SVG files.

### Description:

The svg tool creates Scalable Vector Graphics ([SVG](#)) files from atom snapshots. The SVG format can be displayed or animated by various tools and is a popular format for viewing solid state lattices.

The svg constructor takes a data object containing atom snapshots as an argument ([dump, data](#)).

The show() method creates an image.svg file for snapshot N. The all() method loops thru all selected snapshots and creates the image files image0000.svg, image0001.svg, etc. The prefix "image" can be changed via the file setting.

The bg(), size(), rotate(), trans(), zoom(), box(), label(), and nlabel() methods control various aspects of the images produced. Without the trans() and zoom() settings, the Raster3d image should roughly fill the window and be centered.

Additional movie effects can be produced using the pan() and select() methods. The pan() method specifies an initial and final viewpoint that is applied to the images produced by the all() method. For intermediate images, the view parameters will be interpolated between their initial and final values. The pan() method can thus be used to rotate a single image or fly-by the simulation as it animates. The select() method performs additional atom selection for each image of the all() sequence. An image-dependent %g variable can be used in the select() string. The select() method can thus be used to slice thru the data set.

The acol(), arad(), bcol(), brad(), and tcol() methods change attributes of the atoms, bonds, and triangles displayed. Each atom or bond returned from the data object has an integer "type" from 1 to N. The type is used to index into a list of RGB colors or radii for atoms and bond thickness. The adef(), bdef(), and tdef() methods setup default mappings of types to colors/radii. The other methods enable specific assignments to be made. The interpolation option (e.g. many types assigned to a few colors), enables a smooth rainbow of colors to be assigned to a range of types. Note that the [dump](#) tool allows any vector to be returned as an atom "type" via its atype setting. Thus displayed colors can be keyed to atom velocity or other properties.

Colors are specified with a string, e.g. "red". There are 140 pre-defined colors from [this WWW page](#) which can be examined by importing the "colors" variable from "vizinfo". New colors can be defined by assigning a nickname of your choice to an RGB triplet, as described below.

### Usage:

```
s = svg(d)                create SVG object for data in d

d = atom snapshot object (dump, data)

s.bg("black")             set background color (def = "black")
s.size(N)                 set image size to NxN
s.size(N,M)               set image size to NxM
s.rotate(60,135)          view from z theta and azimuthal phi (def = 60,30)
s.shift(x,y)              translate by x,y pixels in view window (def = 0,0)
s.zoom(0.5)               scale image by factor (def = 1)
s.box(0/1/2)              0/1/2 = none/variable/fixed box
s.box(0/1/2,"green")      set box color
s.box(0/1/2,"red",4)      set box edge thickness
s.file = "image"          file prefix for created images (def = "image")

s.show(N)                 show image of snapshot at timestep N

s.all()                   make images of all selected snapshots
s.all(P)                  images of all, start file label at P
s.all(N,M,P)              make M images of snapshot N, start label at P
```

```

s.pan(60,135,1.0,40,135,1.5)    pan during all() operation
s.pan()                          no pan during all() (default)

args = z theta, azimuthal phi, zoom factor at beginning and end
values at each step are interpolated between beginning and end values

s.select = "$x > %g*3.0"        string to pass to d.aselect.test() during all()
s.select = ""                    no extra aselect (default)

%g varies from 0.0 to 1.0 from beginning to end of all()

s.label(x,y,"h",size,"red","This is a label")    add label to each image
s.nolabel()                                       delete all labels

x,y coords = -0.5 to 0.5, "h" or "t" for Helvetica or Times font
size = fontsize (e.g. 10), "red" = color of text

s.acol(2,"green")                                set atom colors by atom type (1-N)
s.acol([2,4],["red","blue"])                    1st arg = one type or list of types
s.acol(0,"blue")                                 2nd arg = one color or list of colors
s.acol(range(20),["red","blue"])                if list lengths unequal, interpolate
s.acol(range(10),"loop")                        assign colors in loop, randomly ordered

if 1st arg is 0, set all types to 2nd arg
if list of types has a 0 (e.g. range(10)), +1 is added to each value
interpolate means colors blend smoothly from one value to the next

s.arad([1,2],[0.5,0.3])                        set atom radii, same rules as acol()

s.bcol()                                         set bond color, same args as acol()
s.brad()                                         set bond thickness, same args as arad()

s.tcol()                                         set triangle color, same args as acol()
s.tfill()                                       set triangle fill, 0 fill, 1 line, 2 both

s.lcol()                                         set line color, same args as acol()

s.adeft()                                       set atom/bond/tri/line properties to default
s.bdef()                                        default = "loop" for colors, 0.45 for radii
s.tdef()                                        default = 0.25 for bond thickness, 0 fill
s.ldef()

by default, 100 types are assigned
if an atom/bond/tri/line has type > # defined properties, it becomes type = 1

from vizinfo import colors                      access color list
print colors                                    list defined color names and RGB values
colors["nickname"] = [R,G,B]                   set new RGB values from 0 to 255

140 pre-defined colors: red, green, blue, purple, yellow, black, white, etc

Settings specific to svg tool:

s.thick = 2.0                                   pixel thickness of black atom border

```

## Related tools:

[dump](#), [gl](#), [raster](#), [rasmol](#)

## Prerequisites:

Display program for viewing \*.svg image files.

[Pizza.py WWW Site](#) – [Pizza.py Documentation](#) – [Pizza.py Tools](#)

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## vcr tool

### Purpose:

VCR–style GUI for 3d interactive OpenGL visualization.

### Description:

The vcr tool displays a GUI to do 3d interactive visualization of LAMMPS snapshots or data files. It is a wrapper on the [gl](#) tool which draws the individual images in OpenGL windows

The vcr constructor creates the GUI. Note that multiple OpenGL windows can be run by the same GUI so that multiple views of the same data set can be manipulated simultaneously (or views of different data sets so long as they have the same # of snapshots).

The view can be controlled by the GUI widgets or by invoking the tool methods: play(), stop(), axis(), etc. The frame slider can be dragged to view a desired frame. The mouse can also be used in the OpenGL window to translate, rotate, or zoom the scene. The clipping sliders or methods can be used to narrow the view of displayed data, though their interactivity can be slow for scenes with lots of data.

The reload() method is needed if you change the selection attributes of the underlying data assigned to the [gl](#) tool, such as via the [dump](#) tool's methods. These changes will not be visible in the OpenGL windows until the data is reloaded.

The save() method will save the current OpenGL window contents to a PNG file. If multiple OpenGL windows are being used, multiple files will be created. The save–all checkbox or method will store one file per snapshot if the Play or Back buttons are used to start an animation.

### Usage:

```
v = vcr(gl1,gl2,...)      start vcr GUI with one or more gl windows
v.add(gl)                 add a gl window to vcr GUI
```

Actions (same as GUI widgets):

```
v.first()                 go to first frame
v.prev()                  go to previous frame
v.back()                  play backwards from current frame to start
v.stop()                  stop on current frame
v.play()                  play from current frame to end
v.next()                  go to next frame
v.last()                  go to last frame

v.frame(31)               set frame slider
v.delay(0.4)              set delay slider
```



<code>v.q(5)</code>	set quality slider
<code>v.xaxis()</code>	view scene from x axis
<code>v.yaxis()</code>	view scene from y axis
<code>v.zaxis()</code>	view scene from z axis
<code>v.box()</code>	show bounding box
<code>v.axis()</code>	show xyz axes
<code>v.norm()</code>	recenter and resize the view
<code>v.ortho()</code>	toggle ortho/perspective button
<code>v.reload()</code>	reload all frames from gl viewer data files
<code>v.clipxlo(0.2)</code>	clip scene at x lo fraction of box
<code>v.clipxhi(1.0)</code>	clip at x hi
<code>v.clipylo(0.2)</code>	clip in y
<code>v.clipyhi(1.0)</code>	
<code>v.clipzlo(0.2)</code>	clip in z
<code>v.clipzhi(1.0)</code>	
<code>v.save()</code>	save current scene to file.png
<code>v.file("image")</code>	set filename
<code>v.saveall()</code>	toggle save-all checkbox

### Related tools:

[animate, gl](#)

### Prerequisites:

Python Tkinter package.

[Pizza.py WWW Site](#) – [Pizza.py Documentation](#) – [Pizza.py Tools](#)

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## vec tool

### Purpose:

Read columns of numbers from a file.

### Description:

The vtk tool converts atom snapshots in a LAMMPS dump file to the VTK format used by various visualization packages.

The vtk constructor takes a Pizza.py object that stores atom snapshots (e.g. dump or data). Optionally, a file prefix for the VTK output files can also be specified. A ".vtk" suffix will be appended to all output files. The file prefix can also be specified by the file setting.

The one(), many(), and single() methods convert specific snapshots to VTK format and write them out.

### Usage:

```
v = vec("file1")                                read in numeric vectors from a file

skip blank lines and lines that start with non-numeric characters
```

```

assign names = "col1", "col2", etc

nvec = v.nvec          # of vectors
nlen = v.nlen          lengths of vectors
names = v.names        list of vector names
x,y,... = l.get(1,"col2",...) return one or more vectors of values
l.write("file.txt")    write all vectors to a file
l.write("file.txt","col1",7,...) write listed vectors to a file

get and write allow abbreviated (uniquely) vector names or digits (1-Nvec)

```

## Related tools:

[data](#), [dump](#)

**Prerequisites:** none

[Pizza.py WWW Site](#) – [Pizza.py Documentation](#) – [Pizza.py Tools](#)

---

## vtk tool

### Purpose:

Convert LAMMPS snapshots to VTK format.

### Description:

The vtk tool converts atom snapshots in a LAMMPS dump or data file to the VTK format used by various visualization packages.

The vtk constructor takes an object that stores atom snapshots ([dump](#), [data](#)) as its first argument. Optionally, a file prefix for the XYZ output files can also be specified. A ".xyz" suffix will be appended to all output files. The file prefix can also be specified by the file setting.

The one(), many(), and single() methods convert specific snapshots to the VTK format and write them out.

### Usage:

```

v = vtk(d)          d = object containing atom coords (dump, data)

v.one()             write all snapshots to tmp.vtk
v.one("new")        write all snapshots to new.vtk
v.many()            write snapshots to tmp0000.vtk, tmp0001.vtk, etc
v.many("new")       write snapshots to new0000.vtk, new0001.vtk, etc
v.single(N)         write snapshot for timestep N to tmp.vtk
v.single(N,"file")  write snapshot for timestep N to file.vtk

surfaces in snapshot will be written to SURF1.vtk, SURF2.vtk, etc
where each surface (triangle type) is in a different file

```

## Related tools:

[data](#), [dump](#), [xyz](#)

**Prerequisites:** none

## xyz tool

### Purpose:

Convert LAMMPS snapshots to XYZ format.

### Description:

The xyz tool converts atom snapshots in a LAMMPS dump or data file to the XYZ format used by various visualization packages.

The xyz constructor takes an object that stores atom snapshots ([dump](#), [data](#)) as its first argument. Optionally, a file prefix for the XYZ output files can also be specified. A ".xyz" suffix will be appended to all output files. The file prefix can also be specified by the file setting.

The one(), many(), and single() methods convert specific snapshots to the XYZ format and write them out.

### Usage:

<code>x = xyz(d)</code>	<code>d = object containing atom coords (dump, data)</code>
<code>x.one()</code>	write all snapshots to tmp.xyz
<code>x.one("new")</code>	write all snapshots to new.xyz
<code>x.many()</code>	write snapshots to tmp0000.xyz, tmp0001.xyz, etc
<code>x.many("new")</code>	write snapshots to new0000.xyz, new0001.xyz, etc
<code>x.single(N)</code>	write snapshot for timestep N to tmp.xyz
<code>x.single(N, "file")</code>	write snapshot for timestep N to file.xyz

### Related tools:

[data](#), [dump](#), [vtk](#)

**Prerequisites:** none